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[Title of the Invention] IMAGE READING APPARATUS

[Claims]

[Claim 1] An image reading apparatus for reading an image
by emitting light from a light source onto the surface of an
10 original and converting the light reflected from or passed through
the surface of the original into an electrical signal, comprising:

color image pick-up means having groups of pick-up elements
corresponding to a plurality of colors, the groups of pick-up
elements including a plurality of pick-up element trains which
15 are arranged in parallel to one another on a substrate, the
pick-up element train being formed with a plurality of pick-up
elements arranged linearly;

an A/D conversion portion for subjecting pixel output data
of said color image pick-up means to A/D conversion;

20 pixel data storage means for storing the pixel data subjected
by said A/D conversion portion to the A/D conversion; and

averaging means for applying an averaging process to a
plurality of adjoining pixel data on each line stored in said
pixel data storage means.

25 [Claim 2] An image reading apparatus as claimed in claim
1, further comprising input means capable of setting a mode
of reading an image different in resolution or image quality,
wherein

the image is read according to the image reading mode set
30 by the input means.

5 [Claim 3] An image reading apparatus as claimed in one of claims 1 or 2, wherein said color image pick-up means is such that said pick-up element train is shifted from another pick-up element train by smaller than the width of said pick-up element in the direction of arranging said pick-up elements.

10 [Claim 4] An image reading apparatus as claimed in one of claims 1 to 3, wherein said pick-up element trains are mutually arranged with a pitch integer times greater than twice the height of said pick-up element in a direction perpendicular to the direction of arranging said pick-up elements.

15 [Claim 5] An image reading apparatus as claimed in one of claims 1 to 4, wherein said groups of pick-up elements correspond to red, green and blue, respectively.

 [Claim 6] An image reading apparatus as claimed in one of claims 1 to 5, wherein said group of pick-up elements include
20 a first element train and a second element train and wherein said second element train is shifted from said first element train by about half the pitch of the width of said pick-up element.

 [Claim 7] An image reading apparatus as claimed in one of claims 1 to 6, wherein said group of pick-up elements have
25 an opening smaller than the light receiving area of said pick-up element and a shielding portion for blocking off the light directed to the peripheral edge portion of said pick-up element.

[Detailed Description of the Invention]

30 [0001]

5 [Technical Field to Which the Invention Belongs]

This invention relates to an image reading apparatus having a color image pick-up means.

[0002]

[Prior Art]

10 Some of the heretofore known image reading apparatus for reading an image on an original by moving a carriage in parallel to the surface of the original, the carriage being loaded with a color image pick-up means having line sensors such as three of CCDs including a number of pick-up elements arranged linearly
15 for respectively reading three primary colors.

[0003]

In the case of an flat-bed type image reading apparatus, for example, an original glass plate formed with a transparent plate such as glass for placing an original thereon is provided
20 on the surface of a box-like casing. A carriage moved by a driving unit in parallel to the original glass plate is provided in the casing. The carriage is loaded with a light source and a color image pick-up means. The light emitted from the light source is reflected from the surface of the original on the
25 original glass plate and concentrated by a condenser lens on the color image pick-up means.

[0004]

In the image reading apparatus, increasing the number of pick-up elements constituting the CCD is needed to improve read
30 resolution in the main scanning direction as the direction of

5 arranging the pick-up elements in the CCD. However, the CCD
tends to increase in size when the number of pick-up elements
is increased while the size of the individual elements remains
equal and there is a problem arising from an increase in costs
as the load of designing an optical system increases. On the
10 other hand, decreasing the size of each element also develops
a problem arising from limitations on production.

[0005]

As disclosed in JP-A-58-19081, there is known a CCD image
sensor having a first optical detector train and a second optical
15 detector train that is shifted from the first optical detector
by about half the width of the individual optical detectors.

In this CCD image sensor, the first optical detector train
is set adjacent to the second optical detector train in the
sub-scanning direction.

20 [0006]

With the CCD image sensor having the plurality of optical
detector trains, read resolution in the main scanning direction
can be doubled in comparison with a CCD image sensor having
a single optical detector train because the same line on the
25 original is to be read by the first and second optical detector
trains.

[0007]

[Problems to be Solved by the Invention]

The output of the pick-up element in the CCD varies with
30 the quantity of incident light and the charge accumulation time

5 required. As the product of the quantity of light and the charge
accumulation time increases, the output proportionally increases
up to a predetermined level. However, the pick-up element has
such characteristics that the output is saturated when the output
reaches the predetermined level and never increased by increasing
10 the quantity of incident light and prolonging the charge
accumulation time. Since the output of the pick-up element
contains an offset level due to a dark current, the dynamic
range of the pick-up element is from the offset level up to
the predetermined level.

15 [0008]

In such an apparatus as this, it has been practiced to
lower the offset level as a noise level when the original is
read in high quality by reducing the dark current by cooling
the CCD image sensor using a Peltier element or the like. Thus,
20 a high-quality image can be read because the dynamic range obtained
from the output of the CCD image sensor is expandable and the
S/N ratio is improvable.

[0009]

Notwithstanding, an expensive part such as the Peltier
25 element needs using when the high-quality image is read through
the method stated above and this also develops the problem of
making the apparatus complicated, thus increasing the cost.

[0010]

An object of the present invention intended to solve the
30 foregoing problems is to provide an image reading apparatus

5 simple in construction for reading a high-quality image without increasing the cost.

Another object of the invention is to provide an image reading apparatus capable of selecting a mode of reading an image different in resolution or image quality.

10 [0011]

[Means for Solving the Problems]

In an image reading apparatus in claim 1 according to the invention, color image pick-up means has groups of pick-up elements corresponding to a plurality of colors, the groups
15 of pick-up elements including a plurality of pick-up element trains which are arranged in parallel to one another on a substrate, the pick-up element train being formed with a plurality of pick-up elements arranged linearly. Pixel data storage means stores the pixel data subjected by the A/D conversion portion to the
20 A/D conversion, and averaging means applies an averaging process to a plurality of adjoining pixel data on each line stored in the pixel data storage means. Therefore, as the plurality of adjoining pixels in the main scanning direction are averaged, a noise component becomes reducible, whereas image quality becomes
25 improvable.

[0012]

Further, as an averaging area means averaging the pixel data read by the plurality of pick-up element trains, obtainable resolution becomes equal to read resolution in the color image
30 pick-up means having one pick-up element train. Consequently,

5 the noise component is reducible without lower the resolution.

[0013]

Further, original reading time can be shortened because the same pixel is not read a plurality of times. Thereby high-speed reading with the noise component reduced is made possible.

10 [0014]

An image reading apparatus in claim 2 according to the invention is provided with input means capable of setting a mode of reading an image different in resolution or image quality, wherein the image is read according to the image reading mode set by the input means. Accordingly, it is possible to select the mode giving priority to resolution or image quality.

[0015]

An image reading apparatus in claim 3 according to the invention is such that in the color image pick-up means, said pick-up element train is shifted from another pick-up element train by smaller than the width of said pick-up element in the direction of arranging said pick-up elements. Accordingly, the original can be read with high resolution in the direction of arranging the pick-up elements, that is, in the main scanning direction.

[0016]

An image reading apparatus in claim 4 according to the invention is such that said pick-up element trains are mutually arranged with a pitch integer times greater than twice the height of said pick-up element in a direction perpendicular to the

5 direction of arranging said pick-up elements. Accordingly,
the same line on the original is read by the whole pick-up element
train even though the color image pick-up means is relatively
moved in the sub-scanning direction perpendicular to the main
scanning direction at a speed integer times greater, whereby
10 the same line can be read with low resolution at high speed.
[0017]

An image reading apparatus in claim 5 according to the
invention is such that said groups of pick-up elements correspond
to red, green and blue, respectively. Accordingly, the original
15 can be read by decomposing the light from the original into the
three primary colors.
[0018]

An image reading apparatus in claim 6 according to the
invention is such that said group of pick-up elements include
20 a first element train and a second element train and wherein
said second element train is shifted from said first element
train by about half the pitch of the width of said pick-up element.
Accordingly, the read resolution in the main scanning direction
can be doubled.

25 [0019]

An image reading apparatus in claim 7 according to the
invention is such that said group of pick-up elements have an
opening smaller than the light receiving area of said pick-up
element and a shielding portion for blocking off the light directed
30 to the peripheral edge portion of said pick-up element.

5 Accordingly, resolution can substantially be improved as the portions read repeatedly by the plurality of elements on the original are decreased.

[0020]

[Mode for Carrying Out the Invention]

10 A plurality of embodiments of the present invention will now be described with reference to the drawings.

(First embodiment)

Referring to Figs. 1 to 4, there is indicated a carriage-moving flat-bed type image reading apparatus as a first
15 embodiment of the invention.

[0021]

As shown in Fig. 2, an original glass plate 1 including a transparent glass plate is provided on the surface of a casing 2. A carriage 3 that is reciprocated by a driving unit (not
20 shown) in parallel to the original glass plate 1 is provided in the casing 2. A light source 4 and a color image pick-up means 5 are mounted in the carriage 3. The light emitted from the light source 4 is reflected from the surface of an original 8 on the original glass plate 1 and also reflected from a plurality
25 of mirrors 6 before being concentrated at the color image pick-up means 5 by a condenser lens 7. The color image pick-up means 5 converts Red light (R), Green light (G) and Blue light (B) into corresponding electric signals and outputs the signals.

Optical path length is thus increased by causing the light
30 to be reflected from the plurality of mirrors 6. A white reference

5 9 having a high reflectance and a uniform reflective surface
is provided in the end portion of the original glass plate 1
in the moving direction of the carriage 3.

[0022]

Fig. 3 is a block diagram illustrating the function and
10 construction of the image reading apparatus thus configured
above.

In Fig. 3, a control unit 14 essentially consists of a
microcomputer including CPU, RAM, ROM and so on and is connected
to an external image processing apparatus such as a personal
15 computer via an interface 15. Further, the control unit 14
assumes control of charge storage time in the color image pick-up
means 5 and selects gamma functions for use in gamma correction,
as will be described below, according to command signals from
the image processing apparatus.

20 [0023]

An A/D converter unit 12 operates to convert data received
from the color image pick-up means 5 via an amplifier 11 into
digital signals and sends the signals to a shading correcting
unit 13. In a case where a read graduation is a 10-bit one,
25 the digital signal is what indicates numeral values from 0 up
to 1,023. The shading correcting circuit 13 uses data resulting
from reading the white reference 9 before the reading operation
in order to correct variation in the sensitivity of each element
in photoelectric conversion element trains and variation in
30 the light quantity of the light source 4. Then the pixel data

5 subjected to the shading correction is sent to an image processing unit 20. The image data subjected to an averaging process in the image processing unit 20 is sent to a gamma-correction unit 16, wherein gamma correction using a predetermined gamma function is carried out, so that the light quantity signal outputted
10 from the image processing unit 20 is converted to an image signal.

In another correction unit 17, color correction, edge emphasis, and conversions such as area expansion/contraction are carried out.

[0024]

15 As shown in Fig. 4, the color image pick-up means 5 includes groups of pick-up elements for reading R, G and B light, respectively. The groups of pick-up elements respectively include pick-up element trains such as two lines of photoelectric conversion element trains including the first photoelectric
20 conversion element trains 51, 53 and 55 as the first element trains and the second photoelectric conversion element trains 52, 54 and 56 as the second element trains formed with the linear pick-up elements such as the photoelectric conversion elements vertically in the direction of moving the carriage 3 shown in
25 Fig. 2. As each pick-up element is a $8\text{ }\mu\text{m} \times 8\text{ }\mu\text{m}$ square according to the first embodiment of the invention, one line of each photoelectric conversion element train is $8\text{ }\mu\text{m}$ wide. The first photoelectric conversion element trains 51, 53 and 55 are arranged by shifting the second photoelectric conversion element trains
30 52, 54 and 56 in the respective groups of pick-up elements by

5 4 μm that is half the width of the pick-up element in the main scanning direction.

[0025]

10 The first photoelectric conversion element trains 51, 53 and 55 and the second photoelectric conversion element trains 52, 54 and 56 in the respective groups of pick-up elements are arranged with a pitch of 32 μm that is four times as great as the height of each pick-up element, that is, with a pitch equivalent to a width of four lines of the photoelectric conversion element trains. Moreover, the second photoelectric conversion element train 56 in the group of pick-up elements for reading R and the first photoelectric conversion element train 53 in the group of pick-up elements for reading G are arranged with a pitch equivalent to a width of four lines of the photoelectric conversion element trains. Further, the first photoelectric conversion element train 54 in the group of pick-up elements for reading G and the first photoelectric conversion element train 55 in the group of pick-up elements for reading B are arranged with a pitch equivalent to a width of four lines of the photoelectric conversion element trains. Therefore, six lines of the photoelectric conversion element trains 51 to 56 are arranged at equal intervals equivalent to a width of four lines of the photoelectric conversion element trains with respect to adjoining photoelectric conversion element trains.

[0026]

30 The charge stored in each photoelectric conversion element

5 train is transferred to shift registers 512, 522, 532, 542,
552 and 562 via transfer gates 511, 521, 531, 541, 551 and 561
in synchronization with a driving signal to be generated at
predetermined intervals. The storage of the charge because
of light from the next read line is started in each photoelectric
10 conversion element train and the charge transferred to each
shift register is outputted sequentially from output portions
571, 572 and 573 on one pixel basis.

[0027]

In the first embodiment of the invention, each photoelectric
15 conversion element train is fabricated so as to read the original
8 with a resolution of 600 dpi (dot per inch) in the main scanning
direction. Consequently, the color image pick-up means 5 can
read one line with a resolution of 1,200 dpi by combining the
pixel data read by the first photoelectric conversion element
20 trains 51, 53 and 55 with respect to R, G and B with the pixel
data read by the second photoelectric conversion element trains
52, 54 and 56 in the position of the carriage 3 shifted by a
width of four lines of the photoelectric conversion element
trains. As will be described below, further, one line can be
25 read better in quality with a resolution of 600 dpi by using
an input means (not shown) to set an image reading mode giving
priority to image quality.

[0028]

A detailed description will now be given of the image
30 processing unit 20 with reference to Fig. 1.

5 The image processing unit 20 includes an averaging circuit 21 as an averaging means and a memory 22 as a pixel data storage means for storing pixel data.

[0029]

10 The memory 22 is a memory for storing the pixel data subjected to analog-to-digital conversion. The averaging circuit 21 is a circuit for performing an average process among a plurality of adjoining pixels on each line stored in the memory 22. Therefore, an area that one pixel reads is read with read resolution by the color image pick-up means having one photoelectric conversion
15 element train with adjoining two pixels in the main scanning direction using the pixel data read by the first photoelectric conversion element trains 51, 53 and 55 and the second photoelectric conversion element trains 52, 54 and 56.

[0030]

20 The operation of the image reading apparatus thus arranged will be described.

 The user connects a personal computer (not shown) to the interface 15 of the image reading apparatus, places the original 8 on the original glass plate 1 and then instructs the reading
25 operation to be performed by making the personal computer designate the range of reading the original 8 and the read resolution.

[0031]

30 When the reading operation is instructed to be performed, the control unit 14 lights the light source 4 so as to move

5 the carriage 3 at a predetermined speed perpendicularly in the
direction of arranging the pick-up elements of each photoelectric
conversion element train. Images of one line are read into
each photoelectric conversion element train of the color image
pick-up means 5 according to the driving signal generated at
10 the predetermined intervals and fed into the image processing
apparatus 10. Read resolution in the sub-scanning direction
is determined by the time needed to read the line that each
photoelectric conversion element train reads and the moving
speed of the carriage 3. For example, the carriage 3 is moved
15 by the width of one photoelectric conversion element train each
time the carriage 3 reads one line on the original 8, whereby
the original can be read with the resolution of 600 dpi in the
sub-scanning direction.

[0032]

20 When the imaging reading mode giving priority to image
quality is set by the input means, that is, when one line is
read with the resolution of 600 dpi, the analog pixel data obtained
from the first photoelectric conversion element trains 51, 53
and 55 and the first photoelectric conversion element trains
25 52, 54 and 56 are converted to digital pixel data by the A/D
converter unit 12. The pixel data subjected by the shading
correcting circuit 13 to shading correction is stored in the
memory 22, and the averaging process is performed between the
two adjoining pixels in the main scanning direction according
30 to the pixel data read by the first photoelectric conversion

5 element trains 51, 53 and 55 and the first photoelectric conversion
element trains 52, 54 and 56. Then the image data subjected
to the averaging process is sent to the gamma-correction unit
16.

[0033]

10 In the image processing unit 20, the averaging process
between the first and second pixels, the averaging process between
the third and fourth pixels, the averaging process between the
fifth and sixth pixels and so forth are sequentially performed
between two pixels on one line basis, thereby a noise component
15 becomes reducible, whereas image quality becomes improvable.

[0034]

The image data subjected to the averaging process is reduced
in noise level to $1/\sqrt{2}$ in comparison with the image data not
subjected to the averaging process. The reduction of the noise
20 level is effective particularly in the image data of the dark
portion where the inclination of the gamma function used in
the gamma-correction unit 16.

[0035]

In the first embodiment of the invention, since each
25 photoelectric conversion element train is disposed with a pitch
equivalent to a width of four lines of the photoelectric conversion
element trains in the sub-scanning direction, all the
photoelectric conversion element trains 51 to 56 can read the
same line even though the carriage 3 is moved twice or four
30 times greater when reading is carried out at 600 dpi as the

5 photoelectric conversion element trains read at high speed with
a resolution of 300 dpi or 150 dpi in the sub-scanning direction
when the read resolution of the photoelectric conversion element
trains is 600 dpi. Therefore, high-speed reading becomes
possible when the reading is carried out with high resolution
10 in the main scanning direction and with low resolution in the
sub-scanning direction.

[0036]

In the first embodiment of the invention, the pixel data
converted into a digital form is stored in the memory 22, and
15 the averaging process is performed between the adjoining two
pixels in the main scanning direction by the pixel data read
by the first photoelectric conversion element trains 51, 53
and 55 and the pixel data read by the second photoelectric
conversion element trains 52, 54 and 56, thereby the noise
20 component becomes reducible, whereas the S/N ratio becomes
improvable. Accordingly, the image quality can be improved
with a simple construction.

[0037]

In the first embodiment of the invention, further, since
25 an averaging area is obtained by averaging the pixel data read
by the first photoelectric conversion element trains 51, 53
and 55 and the second photoelectric conversion element trains
52, 54 and 56, resolution obtainable becomes equal to the read
resolution of the color image pick-up means having one pick-up
30 element train. Consequently, the noise component is reducible

5 without lowering the resolution.

[0038]

In the first embodiment of the invention, further, the time required when the original 8 is read can be shortened because the same pixel is not read a plurality of times; consequently,
10 high-speed reading with a reduced noise component is made possible thereby.

[0039]

In the first embodiment of the invention, further, the input means is used to set an image reading mode different in
15 resolution or image quality, and the image is read according to the set image reading mode, so that any mode giving priority to resolution or image quality is selectively implemented.

[0040]

Although the image processing unit 20 is placed in the
20 following stage of the shading correcting circuit 13 in the first embodiment of the invention set forth above, the image processing unit 20 may be arranged in the preceding stage of the shading correcting circuit 13.

[0041]

25 Although each photoelectric conversion element train is disposed with the pitch equivalent to the width of four lines of the photoelectric conversion element trains in the first embodiment of the invention, moreover, such a photoelectric conversion element train may be disposed with any given integer
30 train pitch greater than a two-line pitch according to the

5 invention. When the photoelectric conversion element train
with the read resolution being 600 dpi in the main scanning
direction is employed, an arrangement of photoelectric conversion
element trains with a two-line pitch allows each photoelectric
conversion element train to read the same line when high-speed
10 reading is carried out with the resolution of 300 dpi by moving
the carriage mounted with the photoelectric conversion element
trains at a speed twice as great as the read resolution being
600 dpi in the sub-scanning direction. An arrangement of
photoelectric conversion element trains with a three-line pitch
15 also allows each photoelectric conversion element train to read
the same line when high-speed reading is carried out with the
resolution of 200 dpi. Further, an arrangement of photoelectric
conversion element trains with a six-line pitch allows each
photoelectric conversion element train to read the same line
20 when high-speed reading is carried out with the resolution of
300 dpi, 200 dpi and 100 dpi. This is also the cases where
photoelectric conversion element trains with any other resolution
are employed and where photoelectric conversion element trains
with a pitch integer times the width of one line of photoelectric
25 conversion element train are arranged.

[0042]

(Second embodiment)

Fig. 5 shows a second embodiment of the invention.

In the second embodiment of the invention, the photoelectric
30 conversion element trains in the first embodiment thereof are

5 arranged adjacently in the sub-scanning direction with the rest of arrangement being similar to that in the first embodiment thereof. Accordingly, like reference characters refer to like components in the first embodiment thereof.

[0043]

10 As shown in Fig. 5, a color image pick-up means 60 includes groups of pick-up elements for reading R, G and B light, respectively. The groups of pick-up elements respectively include pick-up element trains such as two lines of photoelectric conversion element trains including the first photoelectric
15 conversion element trains 61, 63 and 65 as the first element trains and the second photoelectric conversion element trains 62, 64 and 66 as the second element trains formed with the linear pick-up elements such as the photoelectric conversion elements vertically in the direction of moving the carriage. The first
20 photoelectric conversion element trains 61, 63 and 65 are arranged by shifting the second photoelectric conversion element trains 62, 64 and 66 in the respective groups of pick-up elements by substantially half the pitch of the pick-up element in the main scanning direction.

25 [0044]

The first photoelectric conversion element trains 61, 63 and 65 and the second photoelectric conversion element trains 62, 64 and 66 in the respective groups of pick-up elements are arranged adjacently in the sub-scanning direction. The charge
30 stored in each photoelectric conversion element train is

5 transferred to shift registers 612, 622, 632, 642, 652 and 662
via transfer gates 611, 621, 631, 641, 651 and 661 in
synchronization with a driving signal to be generated at
predetermined intervals. The storage of the charge because
of light from the next read line is started in each photoelectric
10 conversion element train and the charge transferred to each
shift register is outputted sequentially from output portions
671, 672 and 673 on one pixel basis.

[0045]

Even in the second embodiment of the invention, the original
15 can be read with high resolution in the direction of arranging
the pick-up elements, that is, in the main scanning direction.

The noise component in the main scanning direction is made
reducible, whereas the S/N ratio is made improvable by setting
the image reading mode giving priority to image quality.

20 [0046]

(Third embodiment)

Fig. 6 shows a photoelectric conversion element train of
the color image pick-up means in the image reading apparatus
according to a third embodiment of the invention, wherein A
25 is a plan view and B is a side sectional view.

[0047]

In the third embodiment of the invention, an opening smaller
than the light receiving area of each element is formed on the
light receiving side of each photoelectric conversion element
30 train and a shielding portion 58 for shielding the light directed

5 to the peripheral edge portion of each element is provided. Although the shielding portion 58 provided to the photoelectric conversion element train 51 is shown in Fig. 6, such a shielding portion is also provided to each of the photoelectric conversion element trains 52 to 56. The shielding portion 58 is formed
10 of a metal plate and a square opening 581 of $7\text{ }\mu\text{m} \times 7\text{ }\mu\text{m}$ is formed.

The rest of arrangement herein is similar to that in the first embodiment of the invention shown in Fig. 4.

[0048]

In the third embodiment of the invention, the light directed
15 to the peripheral edge portion of each element is blocked off by the shielding portion 58, whereby resolution can substantially be improved as the portions read repeatedly by a plurality of elements on the original are decreased. Moreover, a lowering of sensitivity arising from a reduction in the light receiving
20 area is minimized because the sensitivity in the central portion is greater than that in the peripheral edge portion.

[0049]

In the embodiments of the invention described above, the invention has been applied to the image reading apparatus wherein
25 the averaging process is performed between two adjoining pixels in the main scanning direction by forming the groups of pick-up elements with the two photoelectric conversion element trains for R, G and B colors and using the pixel data read by the first photoelectric conversion element train and the pixel data read
30 by the second photoelectric conversion element train. However,

5 even in a case where groups of pick-up elements for those colors
are formed with three, four or more of photoelectric conversion
element trains according to the invention, the noise component
in the main scanning direction is made reducible by performing
the averaging process among a plurality of adjoining pixels
10 in the main scanning direction using the pixel data read by
the respective photoelectric conversion element trains.

[0050]

Further, high-speed reading can be carried out with low
resolution in the sub-scanning direction by arranging the
15 photoelectric conversion element trains at equal intervals with
a pitch integer times the width of one line of photoelectric
conversion element train in the sub-scanning direction. In
the case of three lines of photoelectric conversion element
trains, for example, the first photoelectric conversion element
20 train is shifted from the second photoelectric conversion element
train by about a $1/3$ pitch of the length of the pick-up element,
and the second photoelectric conversion element train is shifted
from the third photoelectric conversion element train by about
a $1/3$ pitch of the length thereof, so that the improvement of
25 the resolution in the main scanning direction is made about
three times greater. In the case of four lines of photoelectric
conversion element trains, these photoelectric conversion
element trains are shifted from one another by about a $1/4$ pitch
of the length of the pick-up element likewise, so that the
30 improvement of the resolution in the main scanning direction

5 is made about four times greater.

[0051]

Although one output portion corresponding to the group of pick-up element for each of R, G and B has been provided according to the embodiments of the invention described above,
10 one output portion may be provided for each photoelectric conversion element train.

[0052]

Although the invention has been applied to the carriage-moving flat-bed type image reading apparatus in the
15 embodiments thereof, it may be applicable to a mirror-moving flat-bed type image reading apparatus wherein a color image pick-up means and a condenser lens are fixed, whereas a group of mirrors are moved and to a sheet-feed type wherein an original is read by moving the original or any other image reading apparatus.

20 [Brief Description of the Drawings]

[Figure 1]

A block diagram illustrating the image processing apparatus of an image reading apparatus according to a first embodiment of the invention.

25 [Figure 2]

An exemplary diagram illustrating the image reading apparatus according to the first embodiment of the invention.

[Figure 3]

A block diagram illustrating the function and construction
30 of the image reading apparatus according to the first embodiment

5 of the invention.

[Figure 4]

An exemplary diagram illustrating the color image pick-up means of the image reading apparatus according to the first embodiment of the invention.

10 [Figure 5]

An exemplary diagram illustrating the color image pick-up means of an image reading apparatus according to a second embodiment of the invention.

[Figure 6]

15 A view of a pick-up element train in color image pick-up means of an image reading apparatus according to a third embodiment, A being a plane view and B being a sectional view.

[Description of Reference Numerals and Signs]

20	1	original glass plate
	2	casing
	3	carriage
	4	light source
	5	color image pick-up means
25	6	mirror
	7	condenser lens
	8	original
	12	A/D converter unit
	13	shading correcting circuit
30	14	control unit

5 15 interface
 16 gamma-correction unit
 20 image processing unit
 21 averaging circuit (averaging means)
 22 memory (pixel data storage means)
 10 51, 53, 55first photoelectric conversion element trains
 (pick-up element trains, first element trains)
 52, 54, 56first photoelectric conversion element trains
 (pick-up element trains, second element trains)
 511, 521, 531, 541, 551, 561 transfer gates
 15 512, 522, 532, 542, 552, 562 shift registers
 571, 572, 573 output portions
 581 opening

5 [Designation of Document] ABSTRACT

[Abstract]

[Problem] To provide an image reading apparatus simple in construction for reading a high-quality image without increasing the cost.

10 [Means for Resolution] An image processing unit 20 includes a averaging circuit 21 and a memory 22 for storing pixel data.

The memory 22 is a memory for storing the pixel data subjected to analog-to-digital conversion. The averaging circuit 21 performs an averaging process between two adjoining pixels on
15 each line stored in the memory 22. The digital pixel data is stored in the memory 22 and the averaging process is performed between the two pixels in the main scanning direction using the pixel data read by a first photoelectric conversion element
20 trains and the pixel data read by a second photoelectric conversion element trains. Therefore, the noise component can be reduced, whereas the S/N ratio can be improved. Accordingly, image quality is made improvable with a simple arrangement.

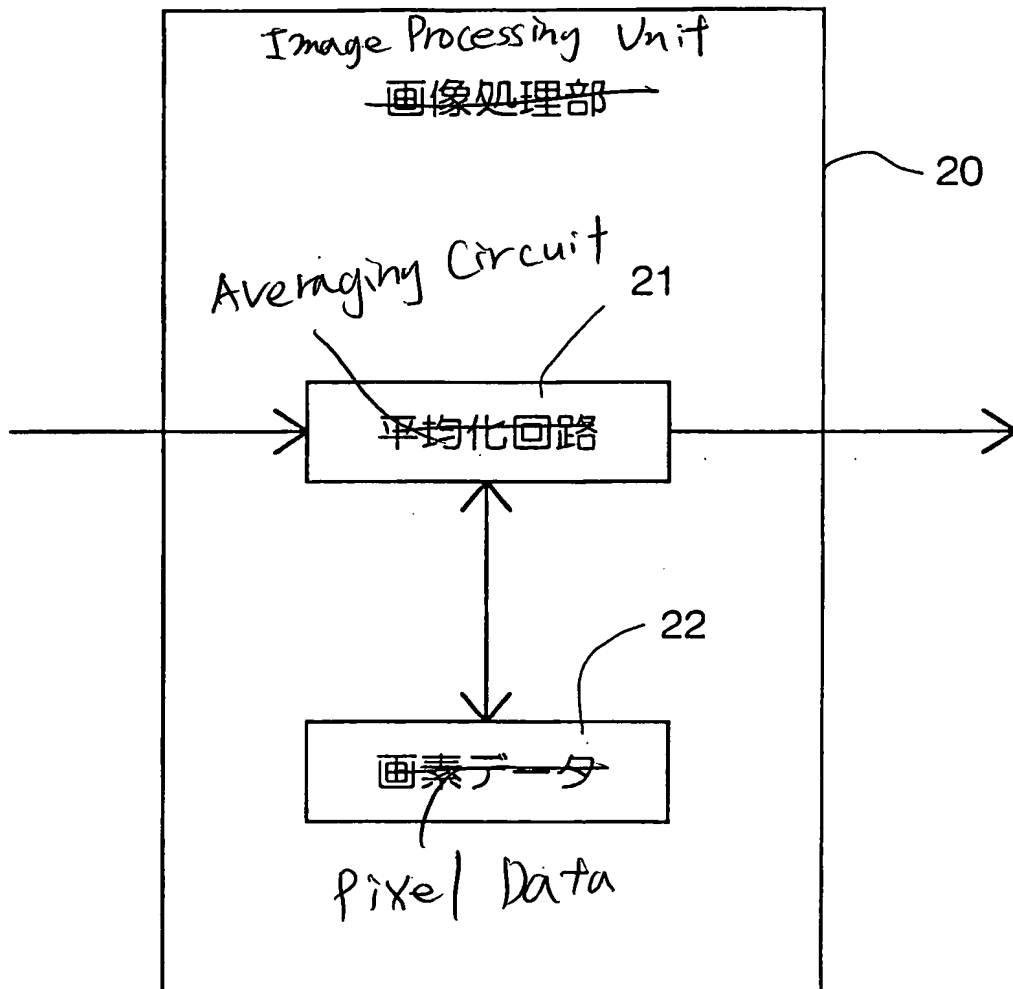
[Selected Figure] Fig. 1

【書類名】

図面

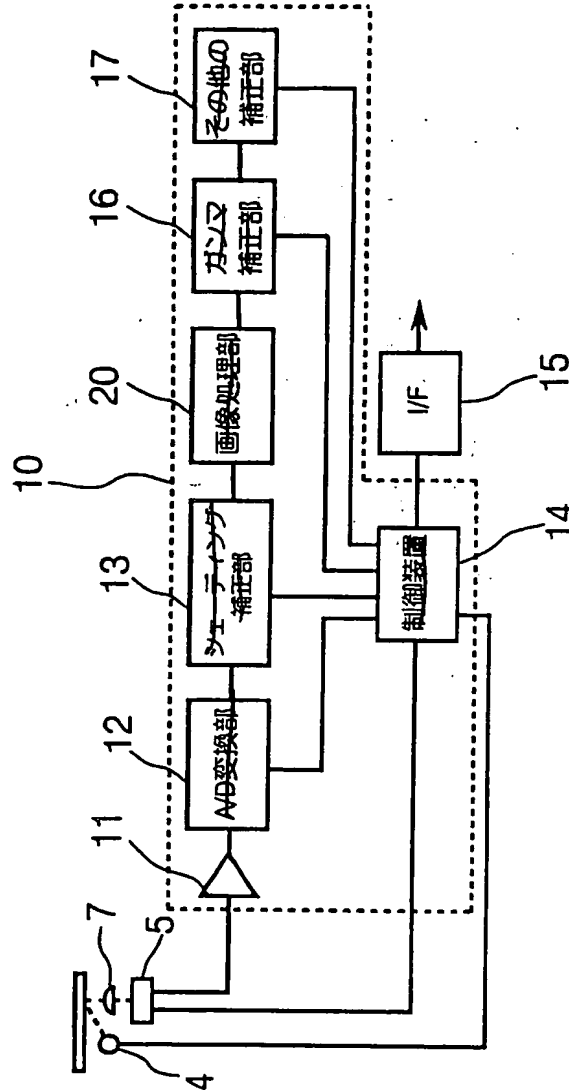
【図 1】

Fig. 1



【図 3】

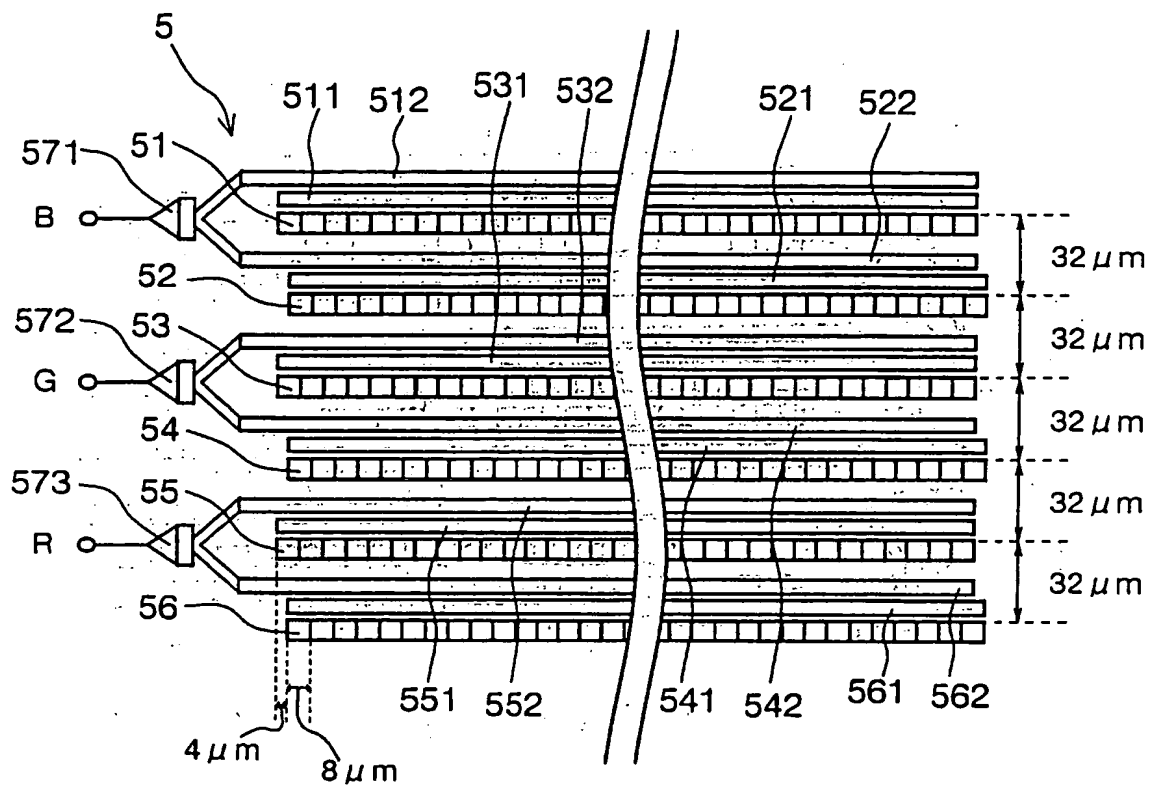
Fig. 3



12...A/D CONVERTER UNIT, 13...SHADING CORRECTING UNIT,
14...CONTROL UNIT, 16...GAMMA-CORRECTION UNIT, 17...ANOTHER
CORRECTING UNIT, 20...IMAGE PROCESSING UNIT.

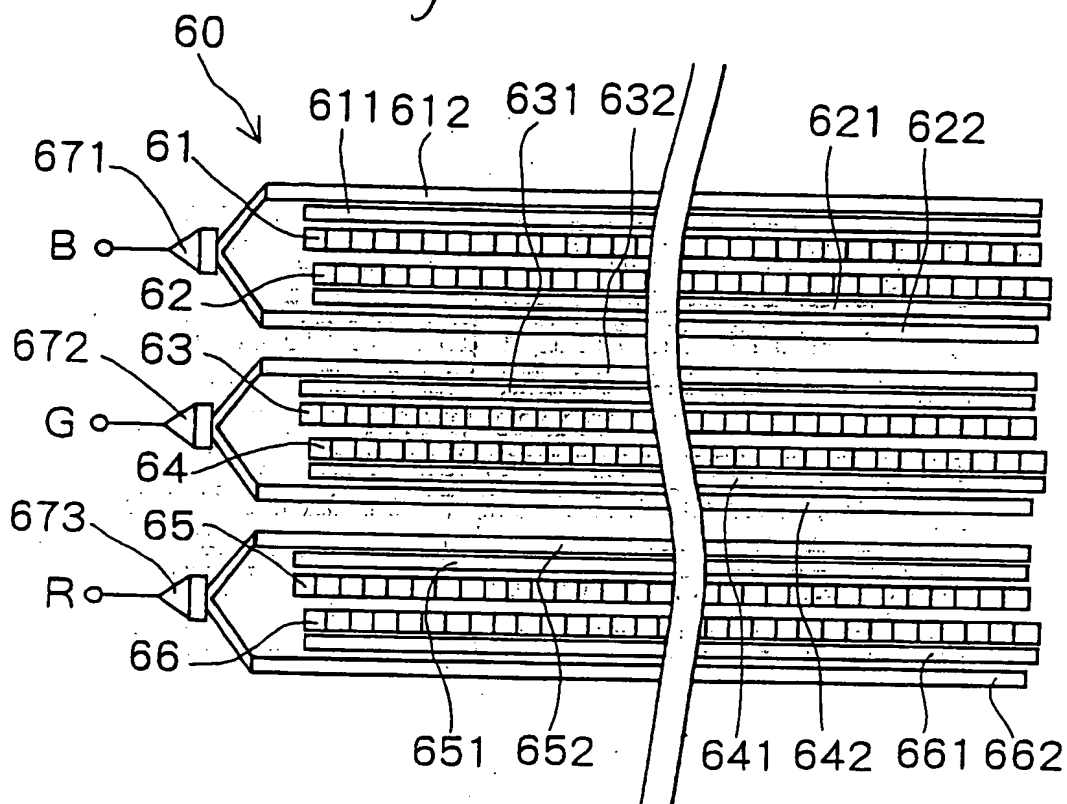
【図 4】

Fig. 4



【図5】

Fig. 5



【図6】

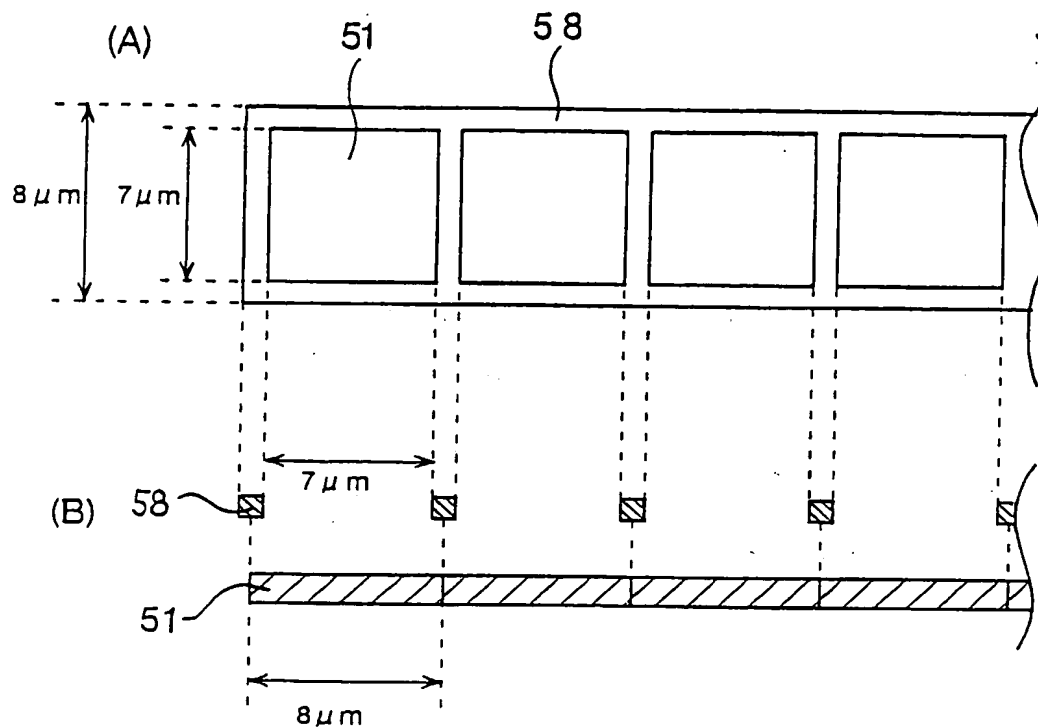


Fig. 6